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DERWENT-WEEK: 199846

TITLE: Manufacturing multilayer ceramic substrate - involving applying
protective sheets to both sides of substrate and capacitor construction and
applying pressure then removing sheets

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ABSTRACTED-PUB-NO: DE19628680A
BASIC-ABSTRACT: The method produces a multilayer ceramic layer with a capacitor which is integrally constructed by common burning of the substrate and the capacitor with a predetermined burning temperature for the substrate in the range of 800 to 1000 deg. C. The method involves forming a substrate laminate arranged between press body insulating layers (11) with a capacitor (19). The press body insulating layers (11) are each formed of a ceramic insulating material which can be burned together at a lower temperature. The capacitor (19) is made of a dielectric press body layer (12). The latter is made of a ceramic dielectric material which can burn at a lower temperature. The capacitor has electrode leads (15) surrounding the dielectric layer (12) in a sandwich structure.

Protective press body sheets (13) are each laminated on both sides of the substrate laminate. The protective sheets (13) are of material which is not sintered at the burning temperature for the substrate. The substrate laminates with the protective sheets (13) are burned at the burning temperature for the substrate. During this, pressure is applied normal to a free surface of one of the protective sheets (13). The pressure applied is between 2 and 20 kgf/cm2. The protective sheets (13) are then removed from both sides of the burned together construction to produce the multilayer ceramic substrate with integral capacitor (19).

ADVANTAGE - Burns substrate and capacitor together to improve manufacturin g efficiency. Prevents curving, bending or deformation of insulating and dielectric layers after heating to ensure a reliable

structure is produced.

ABSTRACTED-PUB-NO: US 5814366A
EQUIVALENT-ABSTRACTS: The method produces a multilayer ceramic layer with a capacitor which is integrally constructed by common burning of the substrate and the capacitor with a predetermined burning temperature for the substrate in the range of 800 to 1000 deg. C. The method involves forming a substrate laminate arranged between press body insulating layers (11) with a capacitor (19). The press body insulating layers (11) are each formed of a ceramic insulating material which can be burned together at a lower temperature. The capacitor (19) is made of a dielectric press body layer (12). The latter is made of a ceramic dielectric material which can burn at a lower temperature.
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ADVANTAGE - Burns substrate and capacitor together to improve manufacturin g efficiency. Prevents curving, bending or deformation of insulating and dielectric layers after heating to ensure a reliable

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CHOSEN-DRAWING: Dwg.1A/3

TITLE-TERMS:
MANUFACTURE MULTILAYER CERAMIC SUBSTRATE APPLY PROTECT SHEET SIDE SUBSTRATE
CAPACITOR CONSTRUCTION APPLY PRESSURE REMOVE SHEET

DERWENT-CLASS: P42 P73 V01

EPI-CODES: V01-B04A3C; V01-B04B7; V01-B04B8A;

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the manufacture method of the ceramic multilayer substrate for carrying Semiconductor LSI, a chip, etc. and carrying out mutual wiring of them.
[0002]
[Description of the Prior Art] In recent years, the low-temperature baking substrate material which consists of a compound constituent of glass and ceramics is developed, and the ceramic low-temperature baking multilayer substrate combined with electrode materials, such as Au, Ag, Pd, and Cu, has been put in practical use.
[0003] Hereafter, the typical example is explained about the manufacture method of the conventional ceramic low-temperature baking multilayer substrate, referring to explanatory drawing of the manufacturing process of drawing 4 .
[0004] First, the slurry which added the organic binder, the plasticizer, and the solvent to the low-temperature baking substrate material of a principal component is prepared. It applies on the organic film 11 by the doctor blade method etc., and this slurry is dried, as shown in the cross section of the green sheet of drawing 4 (a), and a green sheet 12 is produced. Next, as shown in the cross section of the green sheet of drawing 4 (b), hole dawn processing is given to a green sheet 12, and a beer hall 13 is formed. Furthermore, as shown in the cross section of the green sheet of drawing 4 (c), an electric conduction paste is printed to a green sheet 12, and stopgap of a beer hall 13 and formation of an electrode 14 are performed to it.
[0005] Thus, several sheet laminating of the green sheet [finishing / formation of the produced electrode 14] 12 is carried out, and as shown in the cross section of the layered product of drawing 4 (d), the layered product which has an electrode 14 on the outside front face of a inner layer, the best layer, and the lowest layer is produced. And by performing ** binder processing and baking, the multilayer substrate shown in the cross section of drawing 4 (e) is obtained. In addition, after formation of the electrode 14 in the outside front face of the best layer and the lowest layer calcinates a layered product, it may print and calcinate an electric conduction paste and may form it.
[0006]
[Problem(s) to be Solved by the Invention] However, there is a technical problem as shown below in the conventional ceramic multilayer substrate. That is, if the contraction error of substrate material is large when performing surface electrode formation of the best layer since the contraction accompanying [in a ceramic multilayer substrate] sintering to the time of baking arises, and the layered product which has a inner layer electrode is calcinated, since connection between a surface electrode pattern and a inner layer electrode is a size error, it cannot carry out. Consequently, the land of a large area more than required must be formed in a surface electrode so that a contraction error may be permitted beforehand, and it becomes an obstacle in the circuit which needs high-density wiring. Moreover, in accordance with the contraction error, some screen versions for surface electrode formation are prepared, and the method of using it according to the contraction of a multilayer substrate is taken. However, many screen versions

must be prepared by this method, and it is uneconomical.
[0007] On the other hand, although a big land is not needed if surface electrode formation is performed simultaneously with inner layer baking, since the contraction error of the multilayer substrate itself exists as it is also by this simultaneous calcinating method, in cream solder printing at the time of the last chip loading, the case where cream solder printing cannot be carried out happens to a required portion for the error. Moreover, a predetermined chip position and a gap arise also in chip mounting.
[0008] Moreover, a contraction changes by the cross direction and the longitudinal direction with directions of film formation of a green sheet, and it has been an obstacle when producing the ceramic multilayer substrate in which this does not have a position gap, either.
[0009] In order to lessen these contraction errors if possible, in a manufacturing process, it is necessary to manage enough a difference and laminating conditions (the press pressure, temperature) of a fine-particles lot as well as management of substrate material and green-sheet composition. However, generally, even if the several % error of a contraction prepares conditions, it exists, and position precision is high and it is difficult to manufacture a ceramic multilayer substrate without generating of a faulty connection with the sufficient yield.
[0010] this invention solves the above-mentioned trouble, and high-density wiring is possible and it aims at offering the manufacture method of a reliable ceramic multilayer substrate of having suppressed generating of a faulty connection.
[0011]
[Means for Solving the Problem] In order to attain this purpose, the manufacture method of the ceramic multilayer substrate of this invention prepares the 1st green sheet which makes a principal component low-temperature baking substrate material which consists of glass and a compound constituent of ceramics first, and the 2nd green sheet which makes a principal component substrate material which consists of inorganic composition which has sintering temperature higher than this low-temperature baking substrate material, respectively, and applies an electric conduction paste to these green sheets, and an electrode pattern is formed. Next, after doubling the 1st green sheet and 2nd green sheet in which these electrode patterns were formed, in a predetermined number-of-sheets pile, respectively, carrying out a laminating and performing 1st baking for the obtained layered product first, 2nd baking is performed with a burning temperature still higher than the burning temperature in this 1st baking.
[0012]
[Function] According to this manufacture method, if 1st baking is first performed with the low burning temperature corresponding to the sintering temperature of the 1st green sheet, the 2nd green sheet of what the 1st green sheet is sintered and it is going to contract will be held at the state where burning temperature is not sintered to a low sake rather than the sintering temperature, and contraction will hardly take place. Therefore, in the layered product to which the laminating of the 1st green sheet and 2nd green sheet is carried out by sticking, although the 1st green sheet is contracted in the thickness direction, even if it is going to contract in a right-angled direction, i.e., the direction parallel to a laminating side, to the thickness direction, the movement is restrained by the 2nd green sheet and contraction hardly takes place by it.
[0013] Next, if 2nd baking is performed with a high burning temperature corresponding to the sintering temperature of the 2nd green sheet, although contraction by sintering of the 2nd green sheet will start, contraction hardly takes place in the direction where the 2nd green sheet is parallel to a laminating side since the movement is restrained by the 1st already sintered green sheet, but contraction takes place only in the thickness direction. Consequently, the thickness direction is a subject and the contraction by baking of a layered product is hardly generated in a direction parallel to a laminating side. Therefore, it is not necessary to form a land with a big area in the best layer and, and a position gap of the defect of an interlayer connection or an electrode pattern does not occur.
[0014]
[Example] Hereafter, the manufacture method of the ceramic multilayer substrate in the example of this invention is explained.
[0015] (Example 1) To the equivalent compound constituent, hoe lead-silicate glass and the alumina

were weight ratios first, as an organic binder, the phthalic ester was mixed as acrylic resin and a plasticizer, they mixed the methyl ethyl ketone as a solvent, respectively, and it considered as the slurry, and this slurry was applied on the organic film by the doctor blade method, it dried, and the 1st green sheet was produced. Moreover, the 2nd green sheet was produced by the same method as the 1st green sheet using the inorganic composition which consists of a cordylite instead of the above-mentioned compound constituent.

[0016] Next, after giving hole dawn processing to the predetermined position of these green sheets and forming a beer hall in it, the electric conduction paste which makes Ag a principal component was printed, eye beer hall ** and electrode pattern formation were performed, and the 1st and 2nd green sheets which have various electrode patterns were prepared. And as shown in the cross section of the layered product of drawing 1 , the three-sheet pile was made the 2nd green sheet 2, thermocompression bonding of the 2nd green sheet 2 was again made for the 1st green sheet 1 in piles on it, and the layered product which has an electrode 3 on a inner layer and vertical both front faces was produced. In addition, thermocompression bonding conditions are 80 degrees C in heating temperature, andkg [of welding pressure / 200 / /] are [cm] 2. Furthermore, after carrying out ** binder processing of this layered product, 2nd baking was first performed 1st baking and performed at 1000 degrees C continuously with the temperature of 900 degrees C. The belt furnace was used for baking.

[0017] Thus, as a result of investigating the contraction of a direction parallel to the laminating side in the layered product before and behind the baking about the produced ceramic multilayer substrate, the contraction was 0.1% or less and the contraction by sintering was very small. Moreover, the faulty connection was not accepted as a result of performing a continuity check.

[0018] In addition, the manufacture method of performing 1st 900 degrees C baking and 2nd 1000-degree C baking was also tried using the firing furnace different from the above, pressurizing in the vertical direction of the above-mentioned layered product. And when the contraction of the layered product before and behind baking under a pressure was investigated, the contraction of the thickness direction increased rather than the case where a pressure is not applied, and the ceramic multilayer substrate in which the contraction of a direction parallel to a laminating side does not have 0.02% or less and almost contraction was obtained. In addition, even if pressurization does not make required both 1st baking and 2nd baking and not necessarily performs one of baking under a pressure, the contraction of a direction more nearly parallel to a laminating side than the case where there is no pressurization becomes small.

[0019] (Example 2) Using the 1st green sheet 1 which has the electrode pattern produced in the example 1, and the 2nd green sheet 2, as shown in the cross section of the layered product of drawing 2 Following this, the 1st green sheet 1 and the inner layer calcinated by having produced the layered product of composition of consisting of the 2nd green sheet 2 by thermocompression bonding, the 1st [900-degree C] gave 2nd 1000-degree C baking, and the best layer and the lowest layer produced the ceramic multilayer substrate.

[0020] And as a result of investigating the contraction and switch-on before and behind baking like an example 1, the contraction of a direction parallel to a laminating side also in the ceramic multilayer substrate of this example is 0.1% or less, and a faulty connection was not accepted, either.

[0021] (Example 3) Using the 1st green sheet 1 which has the electrode pattern produced in the example 1, and the 2nd green sheet 2, as shown in the cross section of the layered product of drawing 3 , the layered product of composition of that the laminating of the 1st green sheet 1 and 2nd green sheet 2 was carried out by turns was produced by thermocompression bonding, following this, it calcinated, the 1st [900-degree C] gave 2nd 1000-degree C baking, and the ceramic multilayer substrate was produced.

[0022] And as a result of investigating the contraction and switch-on before and behind baking like an example 1, in this case, the contraction of a direction parallel to a laminating side is 0.1% or less, and a faulty connection was not accepted, either.

[0023] In addition, as a burning-temperature range from which a ceramic multilayer substrate with the small contraction of a direction parallel to a laminating side is obtained, 600-1000 degrees C and the 2nd baking process have [the 1st baking process] 800-1500 degrees C desirable in the above-mentioned

examples 1-3, although the example whose burning temperature [in / 900 degrees C and the 2nd baking process / in the burning temperature in the 1st baking process] is 1000 degrees C was shown.

[0024] Moreover, HOU lead-silicate glass and not only the compound constituent of an alumina but the compound constituent as other low-temperature baking substrate material which consists of the glass and ceramics which are used for the 1st green sheet and which was shown in the above-mentioned example as a compound constituent can also be used. You may use low-temperature baking substrate material with sintering temperature higher than the compound constituent which could use an alumina besides the cordylite shown in the above-mentioned example, a magnesia, the zirconia, the titania, the beryllia, the boron nitride, etc. as inorganic composition furthermore used for the 2nd green sheet, and was used for the 1st green sheet.

[0025] Moreover, what makes a principal component metals, such as Pd besides Ag, Ag-Pd, Ag-Pt, and Cu, or an alloy, and the oxide of CuO as an electric conduction paste used for electrode formation can be used.

[0026] Furthermore, in the above-mentioned example, although the example which forms the surface electrode of the best layer and the lowest layer simultaneously with formation of a inner layer electrode was shown, the manufacture method of the ceramic multilayer substrate of this invention is not limited to this, and after it calcinates the layered product in which the inner layer electrode was formed, when forming a surface electrode, it can be applied. Also in this case, since the contraction of a direction parallel to the laminating side of the layered product by baking is very small, a printing gap of a surface electrode pattern does not take place.

[0027]

[Effect of the Invention] So that clearly from the above explanation the manufacture method of the ceramic multilayer substrate of this invention By carrying out a laminating combining two kinds of green sheets from which sintering temperature differs, and giving two baking from which burning temperature differs in this Most contraction of a direction parallel to the laminating side accompanying baking can be lost. Therefore, especially since there is no position gap of an electrode pattern, when forming a surface electrode after baking, generating of a faulty connection with a inner layer electrode is suppressed. Moreover, since it is not necessary to take a position gap into consideration, the high-density ceramic multilayer substrate excellent in the reliability which can make land area small is realized.

[0028] Furthermore, since there are no difference and dispersion of a contraction by substrate material, green-sheet composition, the fine-particles lot, etc., the thing of a fixed size always needs to be obtained and the production yield can improve, and it is not necessary to prepare the screen version for the electrode pattern formation of a large number corresponding to a contraction, and low-cost-ization can be attained.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The process which produces the 1st green sheet which makes a principal component low-temperature baking substrate material which consists of glass and a compound constituent of ceramics, The process which produces the 2nd green sheet which makes a principal component substrate material which consists of inorganic composition which has sintering temperature higher than the aforementioned low-temperature baking substrate material, The process which applies an electric conduction paste to the 1st green sheet of the above, and the 2nd green sheet of the above, respectively, and forms an electrode pattern, The manufacture method of the ceramic multilayer substrate equipped with the process which carries out the laminating of the 2nd green sheet as well as the 1st green sheet in which the aforementioned electrode pattern was formed, the 1st baking process which calcinates this layered product, and the 2nd baking process calcinated with a burning temperature higher than this 1st baking process.
[Claim 2] The manufacture method of the ceramic multilayer substrate according to claim 1 which arranges the 1st green sheet to a inner layer, arranges the 2nd green sheet in the best layer and the lowest layer, respectively, and carries out a laminating in a laminating process.
[Claim 3] The manufacture method of the ceramic multilayer substrate according to claim 1 which arranges the 2nd green sheet to a inner layer, arranges the 1st green sheet in the best layer and the lowest layer, respectively, and carries out a laminating in a laminating process.
[Claim 4] The manufacture method of the ceramic multilayer substrate according to claim 1 which arranges the 1st green sheet and 2nd green sheet by turns, and carries out a laminating in a laminating process.
[Claim 5] The manufacture method of a ceramic multilayer substrate given in any 1 term of the claims 1-4 which perform one [at least] baking under pressurization among the 1st baking process and the 2nd baking process.
[Claim 6] The manufacture method of a ceramic multilayer substrate given in any 1 term of the claims 1-4 whose burning temperature [in / 600-1000 degrees C and the 2nd baking process / in the burning temperature in the 1st baking process] is 800-1500 degrees C.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross section of the layered product before baking of the ceramic multilayer substrate in the 1st example of this invention
[Drawing 2] The cross section of the layered product before baking of the ceramic multilayer substrate in the 2nd example of this invention
[Drawing 3] The cross section of the layered product before baking of the ceramic multilayer substrate in the 2nd example of this invention
[Drawing 4] (a) The cross section of a green sheet used for the conventional ceramic multilayer substrate

(b) The cross section of the green sheet in which this beer hall was formed
(c) The cross section of the green sheet in which the electrode was formed on this beer hall and the front face
(d) The cross section of the layered product of the green sheet in which this electrode was formed
(e) The cross section of the ceramic multilayer substrate which calcinated and obtained this layered product
[Description of Notations]
1 1st Green Sheet
2 2nd Green Sheet
3 Electrode

[Translation done.]